# *Generation Interconnection*
# *Feasibility Study Report*
# *Queue Position Y2-110*

The Interconnection Customer (IC) has requested a 40 MW (40 MWC; 40 MW energy) upgrade to their existing BL England generating facility located in Beesley Point, Upper Township, Cape May County, New Jersey. PJM studied the Y2-110 project as a 40 MW injection into the Atlantic City Electric (ACE) system at the BL England 138kV substation and evaluated the project for compliance with reliability criteria for summer peak conditions in 2016. The planned in-service date is January 1, 2016.

## Point of Interconnection

Y2-110 will utilize the existing Point(s) of Interconnection.

## Direct Connection Requirements

### Transmission Owner Scope of Work

The scope of work and estimated costs for the direct connection facilities is as follows:

### Interconnection Customer Scope of Work

The Interconnection Customer (IC) is responsible for all design and construction related to activities on their side of the Point of Interconnection. Site preparation, including grading and an access road, as necessary, is assumed to be by the IC. Route selection, line design, and right-of-way acquisition of the direct connect facilities is not included in this report, and is the responsibility of the IC.

The IC will be required to install metering and telemetry equipment to provide revenue metering and real-time telemetry data to PJM. The requirements for this equipment are listed in Appendix 2, Section 8 of Attachment O to the PJM Tariff, as well as PJM Manuals 01 and 14D. Protective relaying and metering design and installation must comply with PHI's Applicable Standards.

## Transmission Network Impacts

Potential transmission network impacts are as follows:

### Generator Deliverability

*(Single or N-1 contingencies for the **Capacity** portion only of the interconnection)*

1. The BLE-SCULL#1 138 kV line (from bus 228110 to bus 227905 ckt 1) loads from 98.35% to 103.36% (DC power flow) of its normal rating (219 MVA) for non-contingency condition. This project contributes approximately 10.99 MW to the thermal violation.

Please refer to Appendix 1 for a table containing the generators having contribution to this flowgate.

**Multiple Facility Contingency**

*(Double Circuit Tower Line, Line with Failed Breaker and, Bus Fault contingencies for the **Full** energy output.*

2. The MERION-CORSON 1 138 kV line (from bus 228197 to bus 228106 ckt 1) loads from 98.13% to 103.74% (DC power flow) of its emergency rating (287 MVA) for the tower line contingency outage of CONTINGENCY DESCRIPTION ('AE7TOWER'). This project contributes approximately 16.11 MW to the thermal violation.

   Please refer to Appendix 2 for a table containing the generators having contribution to this flowgate.

**Contribution to Previously Identified Overloads**

*(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)*

1. The SCULL#2-MILL #2 138 kV line (from bus 227906 to bus 227904 ckt 1) loads from 100.68% to 106.39% (DC power flow) of its normal rating (219 MVA) for non-contingency condition. This project contributes approximately 12.49 MW to the thermal violation.

   Please refer to Appendix 3 for a table containing the generators having contribution to this flowgate.

2. The BLE-MDLE TP 138 kV line (from bus 228110 to bus 228111 ckt 1) loads from 106.29% to 111.98% (DC power flow) of its emergency rating (418 MVA) for the tower line contingency outage of CONTINGENCY DESCRIPTION ('AE7TOWER'). This project contributes approximately 23.79 MW to the thermal violation.

   Please refer to Appendix 4 for a table containing the generators having contribution to this flowgate.

3. The LAUREL-WOODTWN2 69 kV line (from bus 228218 to bus 228360 ckt 1) loads from 113.14% to 113.45% (DC power flow) of its emergency rating (108 MVA) for the tower line contingency outage of CONTINGENCY DESCRIPTION ('AE7TOWER'). This project contributes approximately 2.01 MW to the thermal violation.

   Please refer to Appendix 5 for a table containing the generators having contribution to this flowgate.

4. The BLE-SCULL#2 138 kV line (from bus 228110 to bus 227906 ckt 1) loads from 110.84% to 116.54% (DC power flow) of its normal rating (219 MVA) for non-contingency condition. This project contributes approximately 12.49 MW to the thermal violation.

   Please refer to Appendix 6 for a table containing the generators having contribution to this flowgate.

5. The RICHMOND-WANEETA3 230 kV line (from bus 213922 to bus 214012 ckt 1) loads from 123.13% to 123.29% (DC power flow) of its normal rating (760 MVA) for non-contingency condition. This project contributes approximately 7.82 MW to the thermal violation.

   Please refer to Appendix 7 for a table containing the generators having contribution to this flowgate.

6. The LANDIS T-MONROE#3 69 kV line (from bus 228511 to bus 228409 ckt 1) loads from 122.06% to 124.72% (DC power flow) of its emergency rating (158 MVA) for the tower line contingency outage of CONTINGENCY DESCRIPTION ('AE7TOWER'). This project contributes approximately 4.21 MW to the thermal violation.

   Please refer to Appendix 8 for a table containing the generators having contribution to this flowgate.

7. The SHLDLY T-LANDIS T 69 kV line (from bus 228504 to bus 228511 ckt 1) loads from 122.34% to 125.0% (DC power flow) of its emergency rating (158 MVA) for the tower line contingency outage of CONTINGENCY DESCRIPTION ('AE7TOWER'). This project contributes approximately 4.21 MW to the thermal violation.

   Please refer to Appendix 9 for a table containing the generators having contribution to this flowgate.

8. The CNTRL N-SHLDLY T 69 kV line (from bus 228714 to bus 228504 ckt 1) loads from 122.74% to 125.4% (DC power flow) of its emergency rating (158 MVA) for the tower line contingency outage of CONTINGENCY DESCRIPTION ('AE7TOWER'). This project contributes approximately 4.21 MW to the thermal violation.

   Please refer to Appendix 10 for a table containing the generators having contribution to this flowgate.

9. The TUCKAHOE-MILL#2 69 kV line (from bus 228130 to bus 227946 ckt 1) loads from 163.26% to 168.93% (DC power flow) of its emergency rating (146 MVA) for the tower line contingency outage of CONTINGENCY DESCRIPTION ('AE7TOWER'). This project contributes approximately 8.27 MW to the thermal violation.

   Please refer to Appendix 11 for a table containing the generators having contribution to this flowgate.

**Short Circuit**

No issues identified.

**Stability Analysis**

To commence during the System Impact Study.

**Other Charges**

ACE reserves the right to charge the Interconnection Customer Operation and Maintenance expenses to maintain the Interconnection Customer's Attachment Facilities, including metering and telecommunications facilities which are owned by ACE.

**New System Reinforcements**

*(Upgrades required to mitigate reliability criteria violations, i.e. "Network Impacts," initially caused by the addition of this project's generation)*

1. To mitigate the (ACE) BLE-SCULL#1 138 kV line (from bus 228110 to bus 227905 ckt 1) overload will require rebuilding and reconductoring the circuit with a larger conductor. The estimated cost to perform this work is **$2,000,000** and will take **30 months** to complete.

2. To mitigate the (ACE) MERION-CORSON 1 138 kV line (from bus 228197 to bus 228106 ckt 1) overload will require reconductoring approximately 10 miles of the 138kV circuit and upgrading the terminal at Corson substation. The estimated cost to perform this work is **$16,000,000** and will take **24-36 months** to complete.

**Contribution to Previously Identified System Reinforcements**

*(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project.*

1. To mitigate the (ACE) SCULL#2-MILL #2 138 kV line (from bus 227906 to bus 227904 ckt 1) overload will require reconductoring approximately 6.5 miles of 795 ACSR with a larger conductor. The estimated cost to perform this work is **$4,800,000** and will take **30 months** to complete.

2. To mitigate the (ACE) BLE-MDLE TP 138 kV line (from bus 228110 to bus 228111 ckt 1) overload will require reconductoring the BLE-Middle Tap 138 kV line with an ACSS conductor. The estimated cost to perform this work is **$3,000,000** and will take **30 months** to complete.

3. To mitigate the LAUREL-WOODTWN2 69 kV line (from bus 228218 to bus 228360 ckt 1) overload will require upgrading the Woodstown terminal. The estimated cost to perform this work is **$210,000** and will take **6-12 months** to complete.

4. To mitigate the (ACE) BLE-SCULL#2 138 kV line (from bus 228110 to bus 227906 ckt 1) overload will require ACE to complete an existing project to reconductor this line. The project has an in-service date of 2015.

5. To mitigate the (PECO) RICHMOND-WANEETA3 230 kV line (from bus 213922 to bus 214012 ckt 1) overload will require reconductoring the aerial portion of the line which meets the minimum rating requirement of 2882A. This will result in a 249A = 99 MVA margin when compared to the new aerial conductor rating. Using the Pecos conductor avoids the need to rebuild the line. The total aerial mileage per the PECO 230 kV line length spreadsheet is 2.23 miles. Replace with 2-2000 kcmil AAC 127 Str (Cowslip) with emergency rating of 4130. Remove the existing two UG cables (2-3-1x3000 KCMIL CU HPOFP) and replace with two dielectric (XLPE - cross link polyethelene) cables. The estimated cost to perform this work is **$15,000,000** and will take **36 months** to complete.

6/7/8. To mitigate the LANDIS T-MONROE#3 69 kV line (from bus 228511 to bus 228409 ckt 1); SHLDLY T-LANDIS T 69 kV line (from bus 228504 to bus 228511 ckt 1); and the CNTRL N-SHLDLY T 69 kV line (from bus 228714 to bus 228504 ckt 1) overloads will require reconductoring approximately 12 miles of the 0711 circuit and upgrading the Monroe terminal. The estimated cost to perform this work is **$16,200,000** and will take **24-36 months** to complete.

*Note: In addition to the overloads identified in 6/7/8 above, it is expected that there will be possible reconductoring of the Vineland Municipal Electric Utility (VMEU) portion required of the 0711 circuit along with terminal work at the VMEU Central substation. The scope and schedule for this work will be provided as part of the System Impact Study report if it is deemed necessary.*

9. To mitigate the (ACE) TUCKAHOE-MILL#2 69 kV line (from bus 228130 to bus 227946 ckt 1) overload will require reconductoring approximately 12 miles of the 0750 circuit and upgrading the Tuckahoe and Mill terminals. The estimated cost to perform this work is **$13,000,000** and will take **24-36 months** to complete.

**Potential Congestion due to Local Energy Deliverability**

*(PJM also studied the delivery of the energy portion of the surrounding generation. Any potential problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with Network Upgrades to eliminate the operational restriction at their discretion by submitting a Transmission Interconnection Request. Note: Only the most severely overloaded conditions are listed below. There is no guarantee of full deliverability for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which analyzes all overload conditions associated with the identified overloaded element(s). As a result of the aggregate energy resources in the area, the following violations were identified:*

These are ***not*** required reliability upgrades.
None

## Appendix 1

| Bus Number | Bus Name | Full Contribution |
|---|---|---|
| 228100 | BLE DIES | .05 |
| 228101 | BLE#1 ST | .73 |
| 228102 | BLE#2 ST | .97 |
| 228103 | BLE#3 ST | .93 |
| 228200 | CARL#1CT | .05 |
| 228201 | CARL#2CT | .05 |
| 228251 | CARLLS#4 | .27 |
| 228202 | CUMB CT | .2 |
| 228104 | MID#3 CT | .15 |
| 228105 | MID1&2CT | .16 |
| 227807 | MO AV B | -1.24 |
| 228203 | P-006 | .51 |
| 291413 | S-043 | .03 |
| 291065 | S121 | .11 |
| 228206 | SHRMN CT | .18 |
| 292183 | T-054 | .02 |
| 292187 | T-055 | .04 |
| 292512 | T-146 C | 19.01 |
| 292827 | U1-066 1CT | .01 |
| 292828 | U1-066 2CT | .01 |
| 292062 | V1-021 C | .01 |
| 297005 | V2-003 C | .42 |
| 297089 | V2-041 C | . |
| 904081 | V4-009 C | . |
| 904245 | V4-025 C3 | .03 |
| 904531 | V4-054 C | .01 |
| 228700 | VNLD 10 | 1.72 |
| 901051 | W1-021 C | .43 |
| 901061 | W1-022 C | .43 |
| 901071 | W1-023 C | .43 |
| 901281 | W1-085 C | .62 |
| 901291 | W1-086 C | .62 |
| 901301 | W1-087 C | .62 |
| 901311 | W1-088 C | .62 |
| 901321 | W1-089 C | .48 |
| 901461 | W1-117 C | .53 |
| 901471 | W1-118 C | .53 |
| 902321 | W2-039 | 5.14 |
| 903251 | W3-009 C | .19 |
| 903501 | W3-058 C | .67 |
| 903651 | W3-101 C | . |
| 228702 | WEST CT | .05 |

| | | |
|---|---|---|
| 913511 | Y1-077 | 10.99 |
| 914521 | Y2-110 | 10.99 |

## Appendix 2

| Bus Number | Bus Name | Full Contribution |
|---|---|---|
| 228100 | BLE DIES | .07 |
| 228101 | BLE#1 ST | 1.07 |
| 228102 | BLE#2 ST | 1.42 |
| 228103 | BLE#3 ST | 1.36 |
| 292512 | T-146 C | 27.88 |
| 292513 | T-146 E | 111.51 |
| 297005 | V2-003 C | .61 |
| 297006 | V2-003 E | 1. |
| 913511 | Y1-077 | 16.11 |
| 914521 | Y2-110 | 16.11 |

## Appendix 3

| Bus Number | Bus Name | Full Contribution |
|---|---|---|
| 228100 | BLE DIES | .06 |
| 228101 | BLE#1 ST | .83 |
| 228102 | BLE#2 ST | 1.1 |
| 228103 | BLE#3 ST | 1.06 |
| 228200 | CARL#1CT | .05 |
| 228201 | CARL#2CT | .05 |
| 228251 | CARLLS#4 | .3 |
| 228202 | CUMB CT | .22 |
| 228104 | MID#3 CT | .15 |
| 228105 | MID1&2CT | .17 |
| 227807 | MO AV B | -1.96 |
| 228203 | P-006 | .56 |
| 291413 | S-043 | .03 |
| 291065 | S121 | .12 |
| 228206 | SHRMN CT | .2 |
| 292183 | T-054 | .02 |
| 292187 | T-055 | .04 |
| 292512 | T-146 C | 21.6 |
| 292827 | U1-066 1CT | .01 |
| 292828 | U1-066 2CT | .01 |
| 292062 | V1-021 C | .01 |
| 297005 | V2-003 C | .47 |
| 297089 | V2-041 C | . |
| 904081 | V4-009 C | . |
| 904245 | V4-025 C3 | .04 |
| 904531 | V4-054 C | .01 |

| | | |
|---|---|---|
| 228700 | VNLD 10 | 1.89 |
| 901051 | W1-021 C | .48 |
| 901061 | W1-022 C | .48 |
| 901071 | W1-023 C | .48 |
| 901281 | W1-085 C | .68 |
| 901291 | W1-086 C | .68 |
| 901301 | W1-087 C | .68 |
| 901311 | W1-088 C | .68 |
| 901321 | W1-089 C | .53 |
| 901461 | W1-117 C | .59 |
| 901471 | W1-118 C | .59 |
| 902321 | W2-039 | 5.65 |
| 903251 | W3-009 C | .22 |
| 903501 | W3-058 C | .7 |
| 903651 | W3-101 C | . |
| 228702 | WEST CT | .05 |
| 913511 | Y1-077 | 12.49 |
| 914521 | Y2-110 | 12.49 |

## Appendix 4

| Bus Number | Bus Name | Full Contribution |
|---|---|---|
| 228100 | BLE DIES | .11 |
| 228101 | BLE#1 ST | 1.58 |
| 228102 | BLE#2 ST | 2.09 |
| 228103 | BLE#3 ST | 2.02 |
| 292512 | T-146 C | 41.16 |
| 292513 | T-146 E | 164.64 |
| 297005 | V2-003 C | .9 |
| 297006 | V2-003 E | 1.48 |
| 913511 | Y1-077 | 23.79 |
| 914521 | Y2-110 | 23.79 |

## Appendix 5

| Bus Number | Bus Name | Full Contribution |
|---|---|---|
| 228200 | CARL#1CT | .24 |
| 228201 | CARL#2CT | .24 |
| 228251 | CARLLS#4 | 1.39 |
| 228343 | QUINTN#1 | .28 |
| 292512 | T-146 C | 3.48 |
| 292513 | T-146 E | 13.93 |
| 292827 | U1-066 1CT | .06 |
| 292828 | U1-066 2CT | .06 |
| 297005 | V2-003 C | .08 |

| | | |
|---|---|---|
| 297006 | V2-003 E | .12 |
| 297090 | V2-041 E | .19 |
| 297106 | V2-047 E | .09 |
| 904081 | V4-009 C | .03 |
| 904082 | V4-009 E | 1.99 |
| 904223 | V4-023 C2 | .11 |
| 904224 | V4-023 E2 | .17 |
| 904233 | V4-024 C2 | .53 |
| 904234 | V4-024 E2 | .87 |
| 904243 | V4-025 C2 | .32 |
| 904245 | V4-025 C3 | .18 |
| 904247 | V4-025 C4 | .2 |
| 904244 | V4-025 E2 | .52 |
| 904246 | V4-025 E3 | .29 |
| 904248 | V4-025 E4 | .33 |
| 904531 | V4-054 C | .05 |
| 904532 | V4-054 E | 3.51 |
| 904611 | V4-062 C | .25 |
| 904612 | V4-062 E | .4 |
| 228700 | VNLD 10 | 2.24 |
| 901051 | W1-021 C | 2.15 |
| 901052 | W1-021 E | 3.51 |
| 901061 | W1-022 C | 2.15 |
| 901062 | W1-022 E | 3.51 |
| 901071 | W1-023 C | 2.15 |
| 901072 | W1-023 E | 3.51 |
| 901141 | W1-048 C | .27 |
| 901142 | W1-048 E | .43 |
| 901191 | W1-068 C | 1.2 |
| 901192 | W1-068 E | 1.96 |
| 901281 | W1-085 C | .99 |
| 901282 | W1-085 E | 1.62 |
| 901291 | W1-086 C | .99 |
| 901292 | W1-086 E | 1.62 |
| 901301 | W1-087 C | .99 |
| 901302 | W1-087 E | 1.62 |
| 901311 | W1-088 C | .99 |
| 901312 | W1-088 E | 1.62 |
| 901321 | W1-089 C | 1.35 |
| 901322 | W1-089 E | 2.22 |
| 901461 | W1-117 C | 1.51 |
| 901462 | W1-117 E | 2.46 |
| 901471 | W1-118 C | 1.51 |
| 901472 | W1-118 E | 2.46 |
| 902301 | W2-035 C | 1.33 |

| | | |
|---|---|---|
| 902302 | W2-035 E | 2.21 |
| 902321 | W2-039 | 7.6 |
| 902621 | W2-101 C | 1.06 |
| 902622 | W2-101 E | 1.73 |
| 903251 | W3-009 C | 1.22 |
| 903252 | W3-009 E | 1.99 |
| 903652 | W3-101 E | .19 |
| 903891 | W3-157 C | .14 |
| 903892 | W3-157 E | .23 |
| 905512 | W4-089 E | .22 |
| 905522 | W4-090 E | .2 |
| 228702 | WEST CT | .06 |
| 909091 | X2-027 C OP1 | .11 |
| 909092 | X2-027 E OP1 | .17 |
| 909101 | X2-028 C OP1 | .16 |
| 909102 | X2-028 E OP1 | .26 |
| 913511 | Y1-077 | 2.01 |
| 914521 | Y2-110 | 2.01 |

## Appendix 6

| Bus Number | Bus Name | Full Contribution |
|---|---|---|
| 228100 | BLE DIES | .06 |
| 228101 | BLE#1 ST | .83 |
| 228102 | BLE#2 ST | 1.1 |
| 228103 | BLE#3 ST | 1.06 |
| 228200 | CARL#1CT | .05 |
| 228201 | CARL#2CT | .05 |
| 228251 | CARLLS#4 | .3 |
| 228202 | CUMB CT | .22 |
| 228104 | MID#3 CT | .15 |
| 228105 | MID1&2CT | .17 |
| 227807 | MO AV B | -1.96 |
| 228203 | P-006 | .56 |
| 291413 | S-043 | .03 |
| 291065 | S121 | .12 |
| 228206 | SHRMN CT | .2 |
| 292183 | T-054 | .02 |
| 292187 | T-055 | .04 |
| 292512 | T-146 C | 21.6 |
| 292827 | U1-066 1CT | .01 |
| 292828 | U1-066 2CT | .01 |
| 292062 | V1-021 C | .01 |
| 297005 | V2-003 C | .47 |
| 297089 | V2-041 C | . |

| | | |
|---|---|---|
| 904081 | V4-009 C | . |
| 904245 | V4-025 C3 | .04 |
| 904531 | V4-054 C | .01 |
| 228700 | VNLD 10 | 1.89 |
| 901051 | W1-021 C | .48 |
| 901061 | W1-022 C | .48 |
| 901071 | W1-023 C | .48 |
| 901281 | W1-085 C | .68 |
| 901291 | W1-086 C | .68 |
| 901301 | W1-087 C | .68 |
| 901311 | W1-088 C | .68 |
| 901321 | W1-089 C | .53 |
| 901461 | W1-117 C | .59 |
| 901471 | W1-118 C | .59 |
| 902321 | W2-039 | 5.65 |
| 903251 | W3-009 C | .22 |
| 903501 | W3-058 C | .7 |
| 903651 | W3-101 C | . |
| 228702 | WEST CT | .05 |
| 913511 | Y1-077 | 12.49 |
| 914521 | Y2-110 | 12.49 |

## Appendix 7

| Bus Number | Bus Name | Full Contribution |
|---|---|---|
| 219221 | BRL12CT1 | .29 |
| 219222 | BRL12CT2 | .29 |
| 219223 | BRL12CT3 | .29 |
| 219224 | BRL12CT4 | .29 |
| 219127 | BURLNG11 | 1.27 |
| 219103 | BURLNGT8 | 6.39 |
| 219124 | BURLNGT9 | 55.97 |
| 219156 | CAMD CGN | 1.28 |
| 228251 | CARLLS#4 | 1.04 |
| 228000 | CEDR#1CT | 6.71 |
| 228001 | CEDR#2CT | 3.23 |
| 228301 | D/W 1 ST | 18.36 |
| 228302 | D/W 6 ST | 18.83 |
| 219230 | EAGLE P | .17 |
| 219120 | EAGLE PT | 1.38 |
| 219128 | GLOUCSTR | .32 |
| 219134 | MERCER 3 | 24.07 |
| 227807 | MO AV B | 3.88 |
| 219137 | NAT PARK | 8.1 |
| 295841 | Q-090 2 | 4.36 |

| | | |
|---|---|---|
| 228343 | QUINTN#1 | .46 |
| 295952 | R-011 | 23.15 |
| 213918 | RICHMD91 | .51 |
| 213919 | RICHMD92 | .51 |
| 291017 | S-107 1CT | 38.38 |
| 291019 | S-107 1ST | 76.76 |
| 291018 | S-107 2CT | 38.38 |
| 292512 | T-146 C | 13.52 |
| 885600 | T20SOLAR E | .46 |
| 292815 | U1-056 C | 8.97 |
| 292966 | U2-045 C | .5 |
| 293062 | U2-076 | 2.08 |
| 291995 | U4-036 C | .01 |
| 292104 | V1-030 C6 | . |
| 292088 | V1-030 CB | .02 |
| 297005 | V2-003 C | .3 |
| 297082 | V2-035 C | .18 |
| 904221 | V4-023 C1 | 1.57 |
| 904223 | V4-023 C2 | .18 |
| 904231 | V4-024 C1 | .89 |
| 904233 | V4-024 C2 | .87 |
| 904241 | V4-025 C1 | .96 |
| 904243 | V4-025 C2 | .53 |
| 904245 | V4-025 C3 | .13 |
| 904247 | V4-025 C4 | .2 |
| 904281 | V4-029 C | 1.82 |
| 904361 | V4-037 C1 | .9 |
| 904363 | V4-037 C3 | .91 |
| 904401 | V4-041 C | 1.84 |
| 904411 | V4-042 C1 | .9 |
| 904413 | V4-042 C2 | .96 |
| 904611 | V4-062 C | .26 |
| 228700 | VNLD 10 | 4.82 |
| 901051 | W1-021 C | 1.65 |
| 901061 | W1-022 C | 1.65 |
| 901071 | W1-023 C | 1.65 |
| 901141 | W1-048 C | .44 |
| 901191 | W1-068 C | 1.74 |
| 901271 | W1-083 C | .01 |
| 901281 | W1-085 C | 1.58 |
| 901291 | W1-086 C | 1.58 |
| 901301 | W1-087 C | 1.58 |
| 901311 | W1-088 C | 1.58 |
| 901321 | W1-089 C | 1.44 |
| 901331 | W1-090 C OP1 | 1.6 |

| | | |
|---|---|---|
| 901461 | W1-117 C | 1.61 |
| 901471 | W1-118 C | 1.61 |
| 901561 | W1-130 C | .84 |
| 902181 | W2-014 | .02 |
| 902211 | W2-019 C | .36 |
| 902301 | W2-035 C | 1.35 |
| 902321 | W2-039 | 13.05 |
| 902341 | W2-047 C | .93 |
| 902411 | W2-060 C | .05 |
| 902621 | W2-101 C | 1.74 |
| 903251 | W3-009 C | .84 |
| 903301 | W3-026 C | .01 |
| 903311 | W3-028 C | 6.41 |
| 903381 | W3-033 | 1.45 |
| 903401 | W3-041 C | .03 |
| 903471 | W3-048 | 5.51 |
| 903501 | W3-058 C | .74 |
| 903601 | W3-080 C | .05 |
| 903891 | W3-157 C | .15 |
| 903951 | W3-174 | 45.38 |
| 903961 | W3-175 | 87. |
| 905131 | W4-015 C | 40.15 |
| 905141 | W4-016 | 100.38 |
| 905161 | W4-018 C | .9 |
| 905181 | W4-021 | 45.69 |
| 905211 | W4-025 C | .41 |
| 905221 | W4-027 C | .66 |
| 905301 | W4-040 C | .93 |
| 905331 | W4-045 C | .51 |
| 905391 | W4-063 C | .13 |
| 907031 | X1-021 C | .02 |
| 907101 | X1-039 | .19 |
| 907201 | X1-054 C | .03 |
| 907241 | X1-068 | .52 |
| 907251 | X1-070 C | .01 |
| 907261 | X1-071 C | . |
| 907351 | X1-085 C | .21 |
| 909091 | X2-027 C OP1 | .17 |
| 909101 | X2-028 C OP1 | .26 |
| 912101 | X4-015 C | .3 |
| 913511 | Y1-077 | 7.82 |
| 914271 | Y2-078 | 2.03 |
| 914281 | Y2-079 | 20.31 |
| 914301 | Y2-081 C | .58 |
| 914451 | Y2-102 | 45.43 |

| | | |
|---|---|---|
| 914481 | Y2-105 | 18.18 |
| 914521 | Y2-110 | 7.82 |

## Appendix 8

| Bus Number | Bus Name | Full Contribution |
|---|---|---|
| 228100 | BLE DIES | .02 |
| 228101 | BLE#1 ST | .28 |
| 228102 | BLE#2 ST | .37 |
| 228103 | BLE#3 ST | .36 |
| 228200 | CARL#1CT | .12 |
| 228201 | CARL#2CT | .12 |
| 228251 | CARLLS#4 | .71 |
| 228202 | CUMB CT | .25 |
| 228104 | MID#3 CT | .08 |
| 228105 | MID1&2CT | .09 |
| 228203 | P-006 | .51 |
| 228343 | QUINTN#1 | .16 |
| 291413 | S-043 | .13 |
| 291065 | S121 | .46 |
| 228206 | SHRMN CT | .31 |
| 292183 | T-054 | .02 |
| 292187 | T-055 | .06 |
| 292512 | T-146 C | 7.28 |
| 292513 | T-146 E | 29.14 |
| 292827 | U1-066 1CT | .03 |
| 292828 | U1-066 2CT | .03 |
| 292063 | V1-021 E | .03 |
| 297005 | V2-003 C | .16 |
| 297006 | V2-003 E | .26 |
| 297089 | V2-041 C | .01 |
| 297090 | V2-041 E | .4 |
| 297106 | V2-047 E | .18 |
| 904081 | V4-009 C | .01 |
| 904082 | V4-009 E | .84 |
| 904223 | V4-023 C2 | .06 |
| 904224 | V4-023 E2 | .09 |
| 904233 | V4-024 C2 | .3 |
| 904234 | V4-024 E2 | .49 |
| 904243 | V4-025 C2 | .18 |
| 904245 | V4-025 C3 | .09 |
| 904247 | V4-025 C4 | .09 |
| 904244 | V4-025 E2 | .29 |
| 904246 | V4-025 E3 | .15 |
| 904248 | V4-025 E4 | .16 |

| | | |
|---|---|---|
| 904531 | V4-054 C | .03 |
| 904532 | V4-054 E | 1.91 |
| 904611 | V4-062 C | .12 |
| 904612 | V4-062 E | .19 |
| 228700 | VNLD 10 | 7.33 |
| 901051 | W1-021 C | 1.17 |
| 901052 | W1-021 E | 1.91 |
| 901061 | W1-022 C | 1.17 |
| 901062 | W1-022 E | 1.91 |
| 901071 | W1-023 C | 1.17 |
| 901072 | W1-023 E | 1.91 |
| 901141 | W1-048 C | .15 |
| 901142 | W1-048 E | .25 |
| 901191 | W1-068 C | .65 |
| 901192 | W1-068 E | 1.05 |
| 901281 | W1-085 C | 1.72 |
| 901282 | W1-085 E | 2.81 |
| 901291 | W1-086 C | 1.72 |
| 901292 | W1-086 E | 2.81 |
| 901301 | W1-087 C | 1.72 |
| 901302 | W1-087 E | 2.81 |
| 901311 | W1-088 C | 1.72 |
| 901312 | W1-088 E | 2.81 |
| 901321 | W1-089 C | 1.32 |
| 901322 | W1-089 E | 2.17 |
| 901461 | W1-117 C | 1.47 |
| 901462 | W1-117 E | 2.4 |
| 901471 | W1-118 C | 1.47 |
| 901472 | W1-118 E | 2.4 |
| 902301 | W2-035 C | .63 |
| 902302 | W2-035 E | 1.05 |
| 902321 | W2-039 | 15.04 |
| 902621 | W2-101 C | .6 |
| 902622 | W2-101 E | .98 |
| 903251 | W3-009 C | .52 |
| 903252 | W3-009 E | .84 |
| 903501 | W3-058 C | .38 |
| 903502 | W3-058 E | .63 |
| 903651 | W3-101 C | .01 |
| 903652 | W3-101 E | .63 |
| 903891 | W3-157 C | .07 |
| 903892 | W3-157 E | .11 |
| 905512 | W4-089 E | .5 |
| 905522 | W4-090 E | .6 |
| 228702 | WEST CT | .18 |

| | | |
|---|---|---|
| 907472 | X1-110 E | .2 |
| 909091 | X2-027 C OP1 | .06 |
| 909092 | X2-027 E OP1 | .1 |
| 909101 | X2-028 C OP1 | .09 |
| 909102 | X2-028 E OP1 | .15 |
| 913511 | Y1-077 | 4.21 |
| 914521 | Y2-110 | 4.21 |

## Appendix 9

| Bus Number | Bus Name | Full Contribution |
|---|---|---|
| 228100 | BLE DIES | .02 |
| 228101 | BLE#1 ST | .28 |
| 228102 | BLE#2 ST | .37 |
| 228103 | BLE#3 ST | .36 |
| 228200 | CARL#1CT | .12 |
| 228201 | CARL#2CT | .12 |
| 228251 | CARLLS#4 | .71 |
| 228202 | CUMB CT | .25 |
| 228104 | MID#3 CT | .08 |
| 228105 | MID1&2CT | .09 |
| 228203 | P-006 | .51 |
| 228343 | QUINTN#1 | .16 |
| 291413 | S-043 | .13 |
| 291065 | S121 | .46 |
| 228206 | SHRMN CT | .31 |
| 292183 | T-054 | .02 |
| 292187 | T-055 | .06 |
| 292512 | T-146 C | 7.28 |
| 292513 | T-146 E | 29.14 |
| 292827 | U1-066 1CT | .03 |
| 292828 | U1-066 2CT | .03 |
| 292063 | V1-021 E | .03 |
| 297005 | V2-003 C | .16 |
| 297006 | V2-003 E | .26 |
| 297089 | V2-041 C | .01 |
| 297090 | V2-041 E | .4 |
| 297106 | V2-047 E | .18 |
| 904081 | V4-009 C | .01 |
| 904082 | V4-009 E | .84 |
| 904223 | V4-023 C2 | .06 |
| 904224 | V4-023 E2 | .09 |
| 904233 | V4-024 C2 | .3 |
| 904234 | V4-024 E2 | .49 |
| 904243 | V4-025 C2 | .18 |

| | | |
|---|---|---|
| 904245 | V4-025 C3 | .09 |
| 904247 | V4-025 C4 | .09 |
| 904244 | V4-025 E2 | .29 |
| 904246 | V4-025 E3 | .15 |
| 904248 | V4-025 E4 | .16 |
| 904531 | V4-054 C | .03 |
| 904532 | V4-054 E | 1.91 |
| 904611 | V4-062 C | .12 |
| 904612 | V4-062 E | .19 |
| 228700 | VNLD 10 | 7.33 |
| 901051 | W1-021 C | 1.17 |
| 901052 | W1-021 E | 1.91 |
| 901061 | W1-022 C | 1.17 |
| 901062 | W1-022 E | 1.91 |
| 901071 | W1-023 C | 1.17 |
| 901072 | W1-023 E | 1.91 |
| 901141 | W1-048 C | .15 |
| 901142 | W1-048 E | .25 |
| 901191 | W1-068 C | .65 |
| 901192 | W1-068 E | 1.05 |
| 901281 | W1-085 C | 1.72 |
| 901282 | W1-085 E | 2.81 |
| 901291 | W1-086 C | 1.72 |
| 901292 | W1-086 E | 2.81 |
| 901301 | W1-087 C | 1.72 |
| 901302 | W1-087 E | 2.81 |
| 901311 | W1-088 C | 1.72 |
| 901312 | W1-088 E | 2.81 |
| 901321 | W1-089 C | 1.32 |
| 901322 | W1-089 E | 2.17 |
| 901461 | W1-117 C | 1.47 |
| 901462 | W1-117 E | 2.4 |
| 901471 | W1-118 C | 1.47 |
| 901472 | W1-118 E | 2.4 |
| 902301 | W2-035 C | .63 |
| 902302 | W2-035 E | 1.05 |
| 902321 | W2-039 | 15.04 |
| 902621 | W2-101 C | .6 |
| 902622 | W2-101 E | .98 |
| 903251 | W3-009 C | .52 |
| 903252 | W3-009 E | .84 |
| 903501 | W3-058 C | .38 |
| 903502 | W3-058 E | .63 |
| 903651 | W3-101 C | .01 |
| 903652 | W3-101 E | .63 |

| | | |
|---|---|---|
| 903891 | W3-157 C | .07 |
| 903892 | W3-157 E | .11 |
| 905512 | W4-089 E | .5 |
| 905522 | W4-090 E | .6 |
| 228702 | WEST CT | .18 |
| 907472 | X1-110 E | .2 |
| 909091 | X2-027 C OP1 | .06 |
| 909092 | X2-027 E OP1 | .1 |
| 909101 | X2-028 C OP1 | .09 |
| 909102 | X2-028 E OP1 | .15 |
| 913511 | Y1-077 | 4.21 |
| 914521 | Y2-110 | 4.21 |

## Appendix 10

| Bus Number | Bus Name | Full Contribution |
|---|---|---|
| 228100 | BLE DIES | .02 |
| 228101 | BLE#1 ST | .28 |
| 228102 | BLE#2 ST | .37 |
| 228103 | BLE#3 ST | .36 |
| 228200 | CARL#1CT | .12 |
| 228201 | CARL#2CT | .12 |
| 228251 | CARLLS#4 | .71 |
| 228202 | CUMB CT | .25 |
| 228104 | MID#3 CT | .08 |
| 228105 | MID1&2CT | .09 |
| 228203 | P-006 | .51 |
| 228343 | QUINTN#1 | .16 |
| 291413 | S-043 | .13 |
| 291065 | S121 | .46 |
| 228206 | SHRMN CT | .31 |
| 292183 | T-054 | .02 |
| 292187 | T-055 | .06 |
| 292512 | T-146 C | 7.28 |
| 292513 | T-146 E | 29.14 |
| 292827 | U1-066 1CT | .03 |
| 292828 | U1-066 2CT | .03 |
| 292063 | V1-021 E | .03 |
| 297005 | V2-003 C | .16 |
| 297006 | V2-003 E | .26 |
| 297089 | V2-041 C | .01 |
| 297090 | V2-041 E | .4 |
| 297106 | V2-047 E | .18 |
| 904081 | V4-009 C | .01 |
| 904082 | V4-009 E | .84 |

| | | |
|---|---|---|
| 904223 | V4-023 C2 | .06 |
| 904224 | V4-023 E2 | .09 |
| 904233 | V4-024 C2 | .3 |
| 904234 | V4-024 E2 | .49 |
| 904243 | V4-025 C2 | .18 |
| 904245 | V4-025 C3 | .09 |
| 904247 | V4-025 C4 | .09 |
| 904244 | V4-025 E2 | .29 |
| 904246 | V4-025 E3 | .15 |
| 904248 | V4-025 E4 | .16 |
| 904531 | V4-054 C | .03 |
| 904532 | V4-054 E | 1.91 |
| 904611 | V4-062 C | .12 |
| 904612 | V4-062 E | .19 |
| 228700 | VNLD 10 | 7.33 |
| 901051 | W1-021 C | 1.17 |
| 901052 | W1-021 E | 1.91 |
| 901061 | W1-022 C | 1.17 |
| 901062 | W1-022 E | 1.91 |
| 901071 | W1-023 C | 1.17 |
| 901072 | W1-023 E | 1.91 |
| 901141 | W1-048 C | .15 |
| 901142 | W1-048 E | .25 |
| 901191 | W1-068 C | .65 |
| 901192 | W1-068 E | 1.05 |
| 901281 | W1-085 C | 1.72 |
| 901282 | W1-085 E | 2.81 |
| 901291 | W1-086 C | 1.72 |
| 901292 | W1-086 E | 2.81 |
| 901301 | W1-087 C | 1.72 |
| 901302 | W1-087 E | 2.81 |
| 901311 | W1-088 C | 1.72 |
| 901312 | W1-088 E | 2.81 |
| 901321 | W1-089 C | 1.32 |
| 901322 | W1-089 E | 2.17 |
| 901461 | W1-117 C | 1.47 |
| 901462 | W1-117 E | 2.4 |
| 901471 | W1-118 C | 1.47 |
| 901472 | W1-118 E | 2.4 |
| 902301 | W2-035 C | .63 |
| 902302 | W2-035 E | 1.05 |
| 902321 | W2-039 | 15.04 |
| 902621 | W2-101 C | .6 |
| 902622 | W2-101 E | .98 |
| 903251 | W3-009 C | .52 |

| | | |
|---|---|---|
| 903252 | W3-009 E | .84 |
| 903501 | W3-058 C | .38 |
| 903502 | W3-058 E | .63 |
| 903651 | W3-101 C | .01 |
| 903652 | W3-101 E | .63 |
| 903891 | W3-157 C | .07 |
| 903892 | W3-157 E | .11 |
| 905512 | W4-089 E | .5 |
| 905522 | W4-090 E | .6 |
| 228702 | WEST CT | .18 |
| 907472 | X1-110 E | .2 |
| 909091 | X2-027 C OP1 | .06 |
| 909092 | X2-027 E OP1 | .1 |
| 909101 | X2-028 C OP1 | .09 |
| 909102 | X2-028 E OP1 | .15 |
| 913511 | Y1-077 | 4.21 |
| 914521 | Y2-110 | 4.21 |

## Appendix 11

| Bus Number | Bus Name | Full Contribution |
|---|---|---|
| 228100 | BLE DIES | .04 |
| 228101 | BLE#1 ST | .55 |
| 228102 | BLE#2 ST | .73 |
| 228103 | BLE#3 ST | .7 |
| 228251 | CARLLS#4 | .31 |
| 228202 | CUMB CT | .23 |
| 228104 | MID#3 CT | .2 |
| 228105 | MID1&2CT | .22 |
| 227807 | MO AV B | -2.17 |
| 228203 | P-006 | .58 |
| 228206 | SHRMN CT | .21 |
| 292183 | T-054 | .02 |
| 292187 | T-055 | .04 |
| 292512 | T-146 C | 14.3 |
| 292513 | T-146 E | 57.21 |
| 292062 | V1-021 C | .01 |
| 292063 | V1-021 E | .08 |
| 297005 | V2-003 C | .31 |
| 297006 | V2-003 E | .51 |
| 297089 | V2-041 C | . |
| 297090 | V2-041 E | .29 |
| 297106 | V2-047 E | .17 |
| 904082 | V4-009 E | .37 |
| 904245 | V4-025 C3 | .04 |

| | | |
|---|---|---|
| 904246 | V4-025 E3 | .06 |
| 904532 | V4-054 E | .81 |
| 228700 | VNLD 10 | 1.95 |
| 901051 | W1-021 C | .5 |
| 901052 | W1-021 E | .81 |
| 901061 | W1-022 C | .5 |
| 901062 | W1-022 E | .81 |
| 901071 | W1-023 C | .5 |
| 901072 | W1-023 E | .81 |
| 901281 | W1-085 C | .7 |
| 901282 | W1-085 E | 1.15 |
| 901291 | W1-086 C | .7 |
| 901292 | W1-086 E | 1.15 |
| 901301 | W1-087 C | .7 |
| 901302 | W1-087 E | 1.15 |
| 901311 | W1-088 C | .7 |
| 901312 | W1-088 E | 1.15 |
| 901321 | W1-089 C | .55 |
| 901322 | W1-089 E | .9 |
| 901461 | W1-117 C | .61 |
| 901462 | W1-117 E | 1. |
| 901471 | W1-118 C | .61 |
| 901472 | W1-118 E | 1. |
| 902321 | W2-039 | 5.85 |
| 903251 | W3-009 C | .22 |
| 903252 | W3-009 E | .37 |
| 903501 | W3-058 C | .9 |
| 903502 | W3-058 E | 1.47 |
| 903652 | W3-101 E | .17 |
| 905512 | W4-089 E | .19 |
| 905522 | W4-090 E | .18 |
| 907472 | X1-110 E | .48 |
| 913511 | Y1-077 | 8.27 |
| 914521 | Y2-110 | 8.27 |